

Power Sensors Ltd

A Division of Power Standards Lab



PSL - Power Sensors Ltd

a Division of Power Standards

> Founded in 2000 - Alameda CA , USA
> Power Quality Experts - IEC standards
> Manufacturer of leading Power Quality monitors







We Capture All Bad Power Quality





IEC-61000-4-30 Class A Edition 3

- Class A dips/swells/interruptionsClass A mains frequency
- Class A voltage harmonics up to 50th gapless
- Class A flicker Class F1 performance (IEC 61000-4-15)
- Class A Current harmonics up to 50th gapless
- Class A voltage and current unbalances (zero & negative seq)
- Class A Rapid Voltage changes
- 250 nano-seconds High Frequency Transient capture
- 2kHz-150kHz conducted emissions Supra-harmonics



IEC62053-22 Class 0.2S ANSI C12.20 Class 0.2 Revenue Grade Meter Accuracy Including Current Transformers !

PQube 3: sends the information recorded directly to your email inbox !





NO SOFTWARE



PQUBE 3e

Bringing innovation, accuracy, and versatility to Power Analysis







PQube 3

Best Energy Information Device Used as a Real Time Meter







PQube 3

Best Energy Information Device Strip Chart Recorder with min/avg/max values Never miss a single cycle!



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PQube 3

Best Energy Information Device Oscilloscope Triggers Never miss a single cycle!



Monitoring 2 kHz to 150 kHz Emissions Photovoltaic power generation (PV sites)

Residential/commercial area No or low PV penetration



Residential area close to a major PV inverter



2 kHz to 150 kHz Emissions Photovoltaic power generation (PV sites)



Color map : 0.0 – 25.0V



2kHz to 150 kHz Emissions





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Power Sensors Ltd



14 current channels 14 Single Phase Loads

Eight current channels

Monitoring scenarios :

- 3 phase currents, Neutral current, Ground current (5 channels)
 PLUS 3 independent single phase loads
- Or 3 Phase currents , and 5 independent single phase channels









14 current channels 4 Three Phase Loads

14 current channels

Monitoring scenarios :

- 3 phase currents, Neutral current, Ground current (5 channels)
 PLUS 3 independent single phase loads
- Or 3 Phase currents , and 5 independent single phase channels









Four Analog Inputs A multitude of combinations for measurements

Four Analog Inputs +/-10V or +/-60V

Perfect to monitor additional channels:

- Fuel levels (DC, telecom cellular towers..)
- Battery charge currents (DC,UPS, inverters ...)
- Battery voltage (DC, UPS, Inverters...)
- Mobile energy efficiency programs
- Verification of rectifiers noise
- 2kHz ~ 150 kHz rectifier emissions
- Wind speed velocity (Wind turbines)
- Wind turbines blade rotation speed
- Irradiance (sun light intensity (PV sites)
- Machine vibration levels
- And much more







Dual voltage monitoring Great for UPS, DVR, ATS monitoring

Dual voltage monitoring

2 sets of 3 phase voltages:

Ideal for monitoring UPS, DVR , ATS...

- "upstream" set of voltages : flicker, harmonics sags/swells/interruption....
- "downstream" set of voltages: harmonics, sags/swells/interruption....
- 3 load currents







Three USB ports

Three USB ports

Front USB 2.0 port used for :

- Local configuration (read and write)
- Local firmware update
- Local measurement recordings extraction (read)

Two USB 1.0 port used for :

- Connecting ENV2 EnviroSensors
- Adds temperature /humidity /barometric pressure channels
- Adds mechanical shock/ seismic disturbance channels









Touch Screen

Touch Screen

- Can be operated with safety gloves
- Monitor voltage, currents , powers, frequency , harmonics, unbalances, EnviroSensors
- Review recent events directly on screen
- Review the wiring configuration and the waveform before you leave the site...
- Allows to extract measurement recordings on a USB thumb drive or on the extractible 8GB micro SDCard







Digital Input

Digital Input

Triggers an event and recording upon occurrence of for example:

- Protection relay tripping
- ATS transfer switch command
- Overheat
- Process related actuator commands







Environmental Probes

ENV2 EnviroSensors

- Up to 2 ENV2 EnviroSensors to monitor for example, indoor and outdoor conditions
- Adds permanent or real time monitoring and detection (alarms) :
 - > temperature,
 - > humidity,
 - > barometric pressure
- Detect mechanical shocks/seismic disturbances with 3 axis accelerometer recordings









ENV2 EnviroSensors

- Detect mechanical shocks/seismic disturbances with 3 axis accelerometer recordings
- Mechanical shocks
- Tilt angle changes
- Seismic disturbances









Important: What do fab customers owe you?

> Power – clean or not? Reliable or not? Low source impedance or not?

- > Conditioned air temperature, humidity, filtered
- > Process cooling water flow? Contaminants? (Flint Michigan?)
- > Shelter from the elements rain, snow, harsh sun, etc.
- > Good wafers and skilled operators

What else?

Important: Seismic activity and substations

Where do most earthquakes, big and small, happen?



New Seismic disturbance recording for substations and critical loads



Every PQube 3 supports a pair of EnviroSensors – T/H/P/3-axis A

Seismic tremors are <u>extremely</u> local.

- > Constructive and destructive interference
- > Building structure resonance, reflections, nodes and peaks

(450mm problem, especially)

Sensitive! PQube 3 Envirosensor detects micro-tremors, too small for humans to feel, but can disrupt ultra-sensitive mechanical systems – mask align





Rogowski Coils Support

Flexible AC current sensors (Rogowski coils)

- Flexible, IP 65 weather resistant loop
- Plugs directly into your PQube 3 all 14 current inputs
 - no integrator required !
- Calibrated to match PQube 3 impedance
- Nominal 30 to 3000A range



Perfect for applications where limited space makes installation of traditional current transformers difficult or impossible.

No

required



Power Sensors Ltd

ANSI 0.2 Class including Current Transformers!

PSL Ultra-Precise CT Series



With PSL advanced calibration technology, the measurement accuracy exceeds the requirements of Class 0.2, for <u>both</u> the meter <u>and</u> its CT's combined

Every CT comes with its own NIST-Traceable Calibration Certificate (see)

Best amplitude accuracy! ±0.05% typ Best angular accuracy! ±0.07° typ

Best noise immunity! Fully shielded double-insulated cable



Time Synchronization GPS, NTP, SNTP

Time synchronization

GPS Time Synchronization

Perfectly synchronized time stamps to compare results from measurements done at different locations.

The most precise time-stamps available, better than Class A (by a factor of 10!) for power quality

Safest, most noise-free GPS receiver available – PSL-patent-pending full electrical isolation

Also synchronization via NTP and SNTP available





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Latching Relay

Relay output

- Latching relay
- Can be programmed to trip on most of the PQube3 event detected:
- Sags, swells , interruptions
- Frequency
- Current faults
- Analog input (low and high thresholds)

| le Help | | | PQube3 v | ersion 3.3 |
|--|--|--|--|------------|
| Global Default Settings | Restore Defaults | All events on Relay | | |
| EN50160 Settings PQube general info AC voltage Voltage triggering AC current AC additional currents Current triggering Downstream voltage Analog inputs Analog triggering ENV1 EnviroSensor ENV2 accelerometer Event setup | Relay outputs Trigger relay O Trigger relay O Trigger relay on unde Trigger relay on unde Trigger relay on ove Trigger relay on wavesha Trigger relay on wavesha Trigger relay on meu Trigger relay on neu Trigger relay on ea Trigger relay on Trigger relay on Trigger relay on Trigger relay on Trigger relay on | elay on dip n major dip ay on swell interruption frequency n snapshot upe change ase current tral current n 6 current n 18 current n 18 current n 18 current n 19 curre | Trigger relay on AN1 dip Tigger relay on AN1 sweil Tigger relay on AN2 sweil Tigger relay on AN1 - AN2 sweil Tigger relay on AN3 dip Tigger relay on AN3 sweil Ti | |
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SNMP Version 1, 2c and 3 Ready

SNMP Interface

Simple Network Management Protocol

- Manage PQube 3's on the network just like routers, printers and servers ...
- Allows to monitor fleet status in real time
- Reports PQube3 measured parameters in long term charts.
- More than 300 polling registers available
- Compatible with V1, V2C and V3
- Receive immediate notification when event occur - TRAPS

| 4.5 | Time | TrapOID | Host | Category | Severity | Message | | | |
|-----|-------------------------|---|-------------------|-----------------|-----------------|--|------------------------------|--|--|
| 1 | Reset | 110420 | ſ | 1 | 1 | 1 | | | |
| H | Thu Mar 5 17:14:44 2015 | 13.6.14.1.36070.0.1 | 172.17.4.114 | Status Events | Warning | Event Waveshape_Change L1_N 2015-03-05T10:14:14 4222 0.0000 0.0000 Ela | ank 0.000000 TEST office@PSI | | |
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| 1 | Thu Mar 5 17 05 48 2015 | Event Inte | erruption L1_N 20 | 015-03-05T17:41 | 1:17.729Z 03 | 3170 0 0000 Percent 10.000000 980 Atlantic Ave | 000 980 Atlantic Ave | | |
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| 1 | Thu Mar 6 17:04:51:2016 | Event Inte | | 15-05-05117.4 | 1.17.7292 0.0 | 5000 0.0000 Percent 10.000000 580 Atlantic Ave | 00 980 Atlantic Ave | | |
| 1 | Thu Mar 5 17:04:50 2015 | Event | RVC L1_N 2019 | 5-03-05T17:41:1 | 3.224Z 0.008 | 30 183.0000 Volts 4.000000 980 Atlantic Ave | 0.000000 TEST afficie@PS | | |
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| 1 | Thu Mar S 17:04:41 2015 | 22 | | | | | 100 980 Atlantic Ave | | |
| 1 | Thu Mar 5 17:04:38 2015 | Event | RVC L1_N 2019 | 5-03-05T17:21:2 | 25.839Z 0.008 | 30 175.0000 Volts 4.000000 980 Atlantic Ave | 0.000000 TEST affice@PS | | |
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| | | Ever | nt RVC I 1 N 201 | 15-03-05T17:07: | 30.574Z 0.00 | 090 8 0000 Volts 4 000000 980 Atlantic Ave | | | |

SNMP traps

SNMP register polling







MODBUS TCP/IP Ready

Modbus Interface

- More than 3000 registers available
- Simultaneous client connections
- Scan rate up to 3 times a second
- Free Modbus client !
- Waveform voltage and currents Harmonic spectrum
- 2kHz -150kHz spectrum
- In REAL TIME !





KYZ Output

KYZ Output

- PQube3 uses its output relay RLY+ and RLY- for the output toggling function
- Pulse per energy units configured by user (e.g. 1kWh)











480 – 750 - 1200 Volts DC up to 1500 Amps DC

High voltage DC measurements

- Data centers 400VDC
- Metro & Tramway electrification 600 -750 VDC
- PQube 3 can measure :

up to 1200VDC , ATT1 attenuator modules

 up to 1500Amps DC, (Hall effect sensors) – ATT2 modules







PQube 3 is easy to install, anywhere....

PQube 3 Installation options

- On DIN –rail
- On poles
- On walls
- In 19" rack
- Portable



Pre-wired rugged pole-mount



Snap onto DIN-rail



Pre-wired rugged wall-mount



Use your own DIN rail enclosure



PQube 3 Installation

Portable

- Pluggable connections easy field wiring.
- Voltage measurement range 100~480Vac
- 8 current channels
- Relay output, analog and digital inputs
- PQube 3 powered from measured voltage (360~480Vac), or 24Vdc input plug.
- 30-minute internal battery backup for PQube 3
- Fused voltage cables with alligator clips included
- Temperature rating: -20 to +50°C





